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Pacific Region
Canadian Science Advisory Secretariat
Science Response 2013/022

REVIEW AND UPDATE OF SOUTHERN BC CHINOOK CONSERVATION UNIT ASSIGNMENTS

Context

Many populations of Chinook salmon (*Oncorhynchus tshawytscha*) from southern British Columbia, entering the ocean south of Cape Caution, have experienced repeated years of low spawner escapements and there is a high degree of uncertainty about their longer term abundance and productivity. Fisheries and Oceans Canada (DFO) is currently undertaking several initiatives in order to assess the current status of these stocks and to guide the implementation of appropriate actions for their conservation into the future. These actions are within the context of both the Wild Salmon Policy (WSP) and upcoming assessment of status by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (currently scheduled for autumn 2014).

In order to accurately assess the status of salmon stocks under the WSP, methodology was developed to systematically aggregate individual salmon populations into Conservation Units (CUs) (Holtby and Ciruna 2007), hereafter called the "original CU assignments". At the time, participants recognized that the CUs identified would need to be regularly modified as new information, analyses and interpretation became available (DFO 2009). Although the original CU assignments are largely still valid, several inconsistencies and omissions have been noted among southern BC Chinook populations. In preparation for a pre-COSEWIC data review in March 2013, a thorough review of the southern BC Chinook CU assignments has been conducted, resulting in several suggested revisions. Subsequently, there is a need to obtain departmental endorsement of these changes and to disseminate the new information so that it will be reflected in all DFO resources that contain the CU assignments (e.g., regional databases and spatial mapping utilities).

The original CU assignment process and results can be found in Holtby and Ciruna (2007).

Response Report is the result from the Science Special Response Process of February 6, 2013 on the review and update of southern BC Chinook conservation unit assignments.

Background

The WSP's goal is "to restore and maintain healthy salmon populations and their habitats for the benefit and enjoyment of the people of Canada in perpetuity" (DFO 2005). Under the policy, the first strategy identifies the need for 'standardized monitoring of wild salmon statuses' which includes identification of conservation units as the first step. The WSP defines a Conservation Unit as "a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to re-colonize naturally within an acceptable timeframe." (DFO 2005). Methodology for the identification of CUs and a consequent list of draft CUs for all salmon stocks in the Pacific Region (WSP Action Step 1.1) was initially presented in Holtby and Ciruna (2007), and is currently in revision 3 (B. Holtby, pers. comm.). It was recognized at the outset that the CU list would not be static, and the list would change as new analyses and data became available. This response recommends changes to the list of southern BC Chinook CUs that have resulted from a review conducted by the Southern BC Chinook Technical Working Group (SBC-TWG), a

cross-sectorial group with members from First Nations, DFO, BC, conservation organizations and recreational and commercial fishing organizations.

Analysis and Response

The following sections outline the data sources and procedures used over the course of this review, followed by a summary of the proposed changes.

Information Sources

A thorough review of the available information for each population of southern BC Chinook was conducted. This included extraction of relevant salmon escapement data from the New Salmon Escapement Database (NuSEDS) (DFO 2012), as well as summary and review of information found in other DFO databases such as the Enhancement Planning and Assessment Database (EPAD), Chinook Technical Committee (CTC) data files, the Molecular Genetics Lab database, the Mark Recovery Program coded-wire tag (MRP CWT) database and the Pacific Ageing Database System (PADS). A brief overview and link to each data source is included in Appendix A. Wherever possible, gaps in the escapement time series for each population were identified and reasonable attempts were made to track missing data or to document the reason for its absence through communications with hatchery staff, DFO Area Staff, First Nations and non-government organizations. Efforts to ensure the internal and external consistency of the various databases (within and across all data sources) are ongoing. Information from Aboriginal Traditional Knowledge (ATK) and Local Ecological Knowledge (LEK) sources was sought opportunistically by members of the SBC-TWG from local experts in select areas for this report. Additional information from ATK/LEK sources is available but requires a structured process to properly explore and incorporate knowledge to inform the southern BC Chinook rebuilding strategy. Supporting information was also collected from external databases such as the provincially maintained Fisheries Information Summary System (FISS) and Fish Observations database when required for further validation. Finally, in select cases and as a final confirmatory check, the validity of population assignments within a CU was tested using common factor analysis. Further details of this methodology are also found in Appendix A.

Methodology

For review purposes, 36 southern BC Chinook CUs were divided into 2 groups: Fraser River and South Coastal. Each group of CUs was assigned to an informal working group consisting of DFO and SBC-TWG members who had knowledge of the areas and/or populations being reviewed. (Note: The Okanagan CU (CK-01) was omitted from this review because it has previously undergone its own COSEWIC assessment process and will not be considered during the March 2013 pre-COSEWIC review.) Each group held its own series of meetings and conference calls to complete the review process, as outlined below:

1. The most recent list of southern BC Chinook census sites organized by Conservation Unit (Holtby and Ciruna (2007); revision 3) was obtained.
2. Each census site was examined and flagged if:
   a. Its escapement record was not persistent.
   b. Its life history behaviour was not aligned with the life history of the CU.
   c. It was located outside of the geographic boundary of the CU JAZ.
   d. It was in a different genetic reporting group than the CU.
   e. Its run timing was different from the predominant run timing of the CU.
   f. It was sustained solely by enhancement by a transplanted stock.

3. The working groups then identified and flagged census sites that were missed/excluded due to:
   a. Incorrect original CU assignment.
   b. Missing from the original list (overlooked).
   c. Stocks established based solely on transplants.
   d. Missing from NuSEDS.
4. Flagged census sites were followed up to determine their status based on available data sources and analysis tools. As a final step, the working groups used this information to recommend whether census sites flagged in Step 3 warranted inclusion in a CU or not.

If a flagged census site had six or fewer observations greater than zero over the 1953 to 2011 period (< 10% of the time series), this site was deemed to not have a persistent population and was removed from the CU. A new census site was added to a CU if additional information indicated that a persistent population of Chinook had been or is present, regardless of the existence of related NuSEDS escapement records. Both criteria are consistent with Holtby and Ciruna (2007). A census site was moved from its original CU to another CU when local knowledge, updated genetics or geographic information indicated that it had been incorrectly assigned. Appendix B, Table 3 lists all the changes made to census site assignments.

Joint Adaptive Zone

As a starting point, Holtby and Ciruna (2007) partitioned freshwater, estuarine and near-shore marine habitats into freshwater (FAZ), marine (MAZ) and joint adaptive zone (JAZ), where JAZ is signified by the addition of the FAZ and MAZ. Each joint adaptive zone attempts to maximize the within zone similarities and between zone differences on factors likely underlying salmon diversity. The joint adaptive zones provided a preliminary series of conservation units which were then revised based on additional information with respect to life history, ecology and genetics.

Life History and Age Convention

Some conservation units are uniquely identified by their predominant life history behaviour and age at maturity. In these cases, the European ageing convention is used in the CU name to convey this important information. This convention expresses age as two digits separated by a decimal. The first digit equals the number of winters spent in freshwater and the second digit equals the number of winters spent at sea. Adding the two numbers together gives the total age of the fish. For example, CK-17 represents the *Lower Thompson River-spring timing-age 1.2* conservation unit. This is a stream type population (e.g. it generally migrates to sea after one winter in freshwater) that spends two winters at sea, and predominantly returns as three-year-olds.

It is important to note that each population is expected to have a number of ages and/or run timing variants within it. CUs that specify this information are only intended to capture the most common age and run timing of the CU.

Run Timing

Many southern BC conservation units have also been uniquely identified by their predominant adult return run timing. This life history characteristic is assigned based on the definitions outlined by Waples et al. (2004), and is summarized in the following table.

Table 1. Adult return run timing definitions.

Adult Migration Timing	*Timing Name*
March – May	Spring
June	Early Summer
July	Mid Summer
August	Late Summer
September – November	Fall
December – February	Winter

Summary of Recommended Revisions

This response presents the southern BC Chinook CU list last revised on February 6, 2013 (Appendix B, Tables 2 and 3; see Appendix C for the complete list of current southern BC Chinook CUs and census sites). These revisions include 34 current CUs, including 1 newly defined CU. Three former CUs were merged with existing ones based on updated information. Note that the Okanagan CU has not been considered here as it has been reviewed previously under a separate process (COSEWIC 2006).

Although there were some discussions around the initiation of a standardized CU naming convention, agreement on such a scheme could not be reached during this meeting. Subsequently, the issue was tabled for future consideration.

Six populations will require further research to determine their CU assignment, based on Holtby and Ciruna (2007) methodology, or to determine whether or not they have been extirpated. Forty-four new populations were added to CUs based on new information obtained from LEK and ATK. Eighteen populations were moved from one CU to another based on updated run timing, genetics or ecotypic information (Holtby and Ciruna methodology). Six populations were removed due to complete lack of information regarding Chinook presence (either currently or historically).

Conclusions

This review was conducted with the best available data as of October 15, 2012 using escapement estimates up to 2011. This exercise confirms that the CU definitions and assignment of southern BC Chinook census sites from Holtby and Ciruna (2007) were generally correct with only minor modifications. Further reviews and revisions should be conducted and implemented as new information becomes available.

Revisions resulting from this review should be forwarded to DFO database administrators for incorporation into relevant data sources as soon as practicable. This includes EPAD, PADS, and NuSEDS.

The contributors from this process recommend that any future Pacific Region CU reviews should adopt a similar process to confirm revisions and to ensure wide distribution of the associated updates resulting from the review.

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Sources of information

This Science Response Report results form the Science Special Response Process of February 6, 2013 on the Review and Update of southern British Columbia Chinook conservation unit assignments.

The contributors would like to acknowledge Blair Holtby and Melody Farrell for their earlier contributions to the review process.

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Appendix A: Data Sources

New Salmon Escapement Database (NuSEDS)

Salmon spawner enumeration data in the Pacific Region is stored and managed in the New Salmon Escapement Database (NuSEDS) (DFO 2012). The term "escapement" is used to refer to the group of mature salmon that have 'escaped' from various sources of exploitation, and returned to freshwater to spawn and reproduce. This data is assigned to a Census Site, which may be a complete watercourse with a marine terminus, a tributary to a larger watercourse, or a defined reach within a watercourse that may or may not encompass the entire population but represents an index of the abundance of that population.

This database contains historic population data starting in 1953. (Older data for some rivers exists in other formats.) Until 1995, salmon escapement was the responsibility of DFO Conservation and Protection section staff. Information was recorded on a standard single page form (BC-16). This form was used to summarize the estimate of the spawning population size, but it lacked the capacity to describe the number of observations, individual counts or methods used to estimate the abundance of the population. In the early years, the abundance was described categorically by selecting an appropriate numeric range, identified by alphabetic code. For example, Range A was 0-50, Range B was 50-100, etc.

In 1995, responsibility for salmon enumeration was moved to DFO Science section staff. At that time, the Salmon Escapement Database (SEDS) was re-written to include descriptive information for each abundance estimate, providing underlying data and the estimation method(s). This has become known as NuSEDS. With the introduction of the Wild Salmon Policy, individual populations within NuSEDS can now be grouped by Conservation Unit.

Access to NuSEDS data by the public is available through Mapster:

pacgis01.dfo-mpo.gc.ca/Mapster30/#/SilverMapster

Pacific Salmon Commission reports (CTC data files)

Estimates of the spawning abundance for most consistently enumerated BC Chinook salmon populations are assembled and reported annually by the Chinook Technical Committee (CTC) for the Pacific Salmon Commission (PSC). These data are also used as inputs to the annual bilateral exploitation rate analysis of CWT recovery data for designated Chinook salmon CWT indicator stocks and for calibration of the PSC Coastwide Chinook Model. For this reason, data are maintained by Canadian representatives on the CTC and various DFO area staff in a suite of Excel files. The data in these files are reviewed periodically and updated as necessary. They are generally used as the primary source of data for many applications related to Chinook salmon analysis. The maintenance of these data files provides a historical record of data that have contributed to bilateral management under the Pacific Salmon Treaty (PST). These files, or the data contained in them, are available at any time upon request from Canadian CTC members.

Reports by the CTC which provide the annual escapement data present in the CTC Excel files for Canadian Chinook salmon populations can be accessed from the PSC website:

www.psc.org/publications_tech_techcommitteereport.htm#TCCHINOOK

Molecular Genetics Data

The molecular genetics data (MGD) consists of multi-locus genetic data from known fish populations (which form the genetics baseline). Southern BC Chinook are represented by approximately 16,000 individual fish from 128 populations analysed with 15 genetic markers (microsatellites). Further information can be found at:

www.pac.dfo-mpo.gc.ca/science/facilities-installations/pbs-sbp/mgl-lgm/index-eng.htm
or refer to:

Beacham, K. L. Jonsen, J. Supernault, M. Wetklo, L. Deng, and N. Varnavskaya. 2006. Pacific Rim population structure of Chinook salmon as determined from microsatellite variation. Transactions of the American Fisheries Society 135: 1604-1621.

Enhancement Planning and Assessment Database (EPAD)

The Enhancement Planning and Assessment Database (EPAD), administered by the staff of the Salmon Enhancement Program (SEP), is the historical repository for all records of escapement data associated with enhancement activities (various types of broodstock removals), samples of CWTs, individual records of CWT recoveries in escapement programs (occasionally in-river fisheries), estimates of enhanced returns, as well as records of enhanced production and releases of CWTs by species, stock, release strategy and year. Annually, records of CWT releases and recoveries in escapement programs are incorporated into the Mark Recapture Program (MRP) CWT database. Release and recovery records have been coded into the current version of the Chinook CUs. Extractions of enhancement data can be provided upon request to SEP staff.

Pacific Ageing Database System (PADS)

The Pacific Age Database System (PADS), administered by the staff of the DFO Sclerochronology Lab, is the historical repository for age data records obtained from salmon scale, otolith and fin samples. The samples (mainly scales) can originate from a variety of sources including adult spawners, juveniles caught in freshwater or in marine areas, and fish caught in fisheries. The samples may have been obtained opportunistically or from a sampling program designed to be random and representative of the population. Data records in the PADS database include information such as sample source, geographic location of capture, gear, life history stage, catch dates and age determination processes. These records have been associated to CUs based on the geographical location of the age data sample and extractions of data by CU can be obtained by DFO staff from the NuSEDS query interface for the years 1989 to present. Pre-1989 age data (in pdf format) can be obtained from PADS through the Scanned Scale Card query tool. Requests for data can also be submitted directly to the staff of the Sclerochronology Lab.

Mark Recovery Program Coded Wire Tag (MRP CWT) database

The Mark Recovery Program Coded Wire Tag (MRP CWT) database, administered by staff of the Salmon Stock Assessment MRP Unit, contains records of releases and individual recoveries of CWTs from samples of Chinook salmon (and other salmon species) obtained annually from Canadian and US fisheries and from Canadian escapement recovery programs as agreed by Canada and the US under the PST. Recovery records of CWTs observed in fishery and escapement samples are estimated for their contribution to the represented catch and escapement and also further expanded for untagged hatchery production often associated to each CWT release. The MRP database is the source for data in the US-administered Regional Mark Information System (RMIS) database and mirrors CWT recovery records obtained in US

fishery sampling programs. This database can be queried by DFO staff through the following portal:

http://devios-intra/MrpWeb/Extractor

The capacity to query release and recover records according to the defined Chinook CUs is underway. CWT recovery data are used to characterize ocean distribution at age and estimates of brood-, age- and fishery-specific exploitation rates, survival rates and maturation rates can be obtained through a cohort analysis procedure, currently carried out annually for CWT indicator stocks as an obligation under the PST.

Aboriginal Traditional Knowledge and Local Ecological Knowledge (ATK/LEK)

Information from ATK and LEK sources was collected opportunistically from local experts in select areas for this report through a series of meetings and communications. It is important to note that a structured process will be required in order to properly and sufficiently incorporate this source of knowledge into future reviews and assessments.

Fisheries Information Summary System (FISS)

The Fisheries Information Summary System (FISS) was used to provide evidence of spawning presence for populations of southern BC Chinook. FISS provides spatially represented summary level fish and fish habitat data for waterbodies throughout BC and the Yukon. The information is in database format and can be displayed on the 1:50,000 Watershed Atlas. There are 237,558 records in FISS. These records are for 88,460 points or zones on 36,973 waterbodies within the province of British Columbia, including 100,962 records of fish distribution (last updated May 17, 2006). www.env.gov.bc.ca/fish/fiss/index.html

Factor Analysis

Common factor analysis was used to confirm that the escapement trends of populations within a conservation unit varied in a reasonably consistent manner. Populations within a CU are expected to experience similar vulnerabilities and impacts in fisheries or natural mortality in the JAZ environments. The methodology was adapted from similar analyses conducted by Candy et al. (2002), and the results were used to check CU assignments based on other data sources. It is important to note that a lack of agreement among populations identifies populations with differing escapement trends, but does not determine the removal of these census sites from the CU. Other available data, such as ecotype and genetic group, were also considered when making population assignments to CUs. Factor analysis was not used to aggregate CUs previously identified by Holtby and Ciruna (2007).

This analysis used escapement data that were obtained from CTC data files or NuSEDS, depending on availability. Time series were limited to 1996-2011 in order to minimize the number of years of missing values. Because the methodology cannot accommodate missing values, stocks with more than 50% missing values during this time period were excluded from the analysis and time series with less than 50% missing values were infilled with the time series average in order to provide a complete data set. R software (www.r-project.org, v.2.15.1), and the associated package "FactomineR" were used to conduct the analyses.

As examples, the results from factor analyses of data from the Upper Fraser River Spring CU and Adams River Upper CU are presented here. Complete results for all analyses can be obtained by contacting the contributors.

Upper Fraser River-SP-1.3 CU Factor Analysis

A large number of populations are assigned to the Upper Fraser River-SP-1.3 CU. In order to confirm the assignment of some of the lesser known populations, factor analysis was used to investigate their agreement with the general escapement trends of the CU.

Walker Creek was the only population initially assigned to this CU with sufficient data for analysis that did not fit the general escapement trend for the CU (its correlation with the 1st factor equaled 0.278).

- Driscoll Creek (1 record)
- Forgetmenot Creek (NuSEDS comment suggests aggregating with Morkill)
- Kenneth Creek (6 records > 0)
- Otter Creek (2 records >0, NuSEDS suggests this site is inappropriate Chinook habitat)
- Ptarmigan Creek (6 records > 0)
- Robson River (2 records > 0)
- Snowshoe Creek (4 records > 0)

The remaining census sites had correlations greater than 0.4, indicating general agreement with the overall escapement trend for the CU. Note that the Salmon River was almost equivalently correlated with both CK-10 (Middle Fraser-spring timing) and CK-12 (Upper Fraser-spring timing). Subsequently, the genetic reporting group was used to reassign this population to CK-12 (Upper Fraser-spring timing).

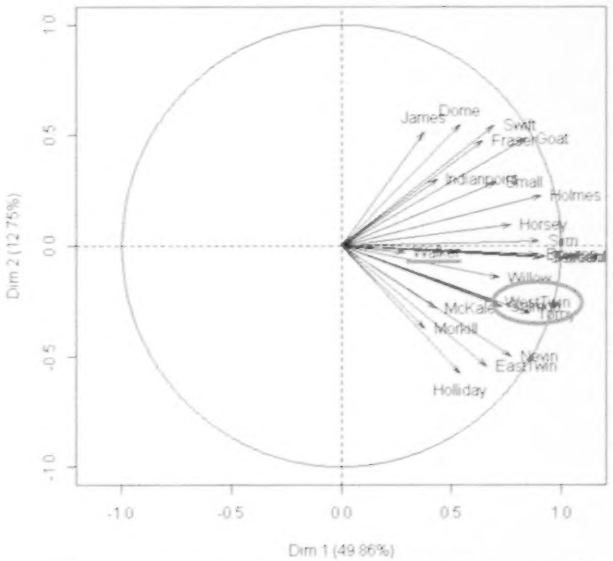

Figure 1. Factor analysis results show the general agreement among populations in the Upper Fraser River-spring timing CU (CK-12). The Salmon River population is circled, showing its agreement with other populations in the CU. Walker Creek, the only population in this analysis that did not fit the general CU escapement trend sufficiently, is underlined.

Several census sites were excluded due to data deficiency (NuSEDS escapement records for 1995-2011):

Adams River Upper Factor Analysis

Factor analysis was used to help evaluate whether the Adams River Upper population should be included in the South Thompson-SU-0.3 or South Thompson-SU-1.3 CUs. This population was recently reintroduced and there was limited information about its life history.

Ultimately, the population did not fit well with either CU. Subsequently, based on genetic and run timing information, it has been recommended that this population form its own CU.

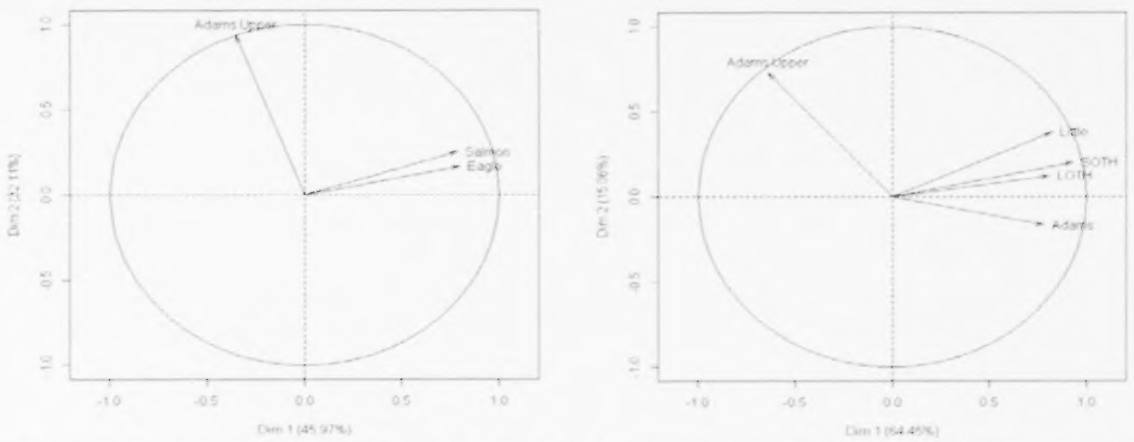

Figure 2. Factor analysis results illustrating the lack of correspondence Adams River – Upper with either the South Thompson – summer timing – age 0.3 or South Thompson – summer timing – age 1.3 conservation units.

Appendix B: List of revised conservation units and sites with rationale for changes

The following tables provide a summary of the proposed revisions to conservation units of southern BC Chinook as well as to the sites/populations within each CU. The associated rationale and/or data source for each change is noted.

Table 2. Proposed revisions to southern BC Chinook Conservation Units

CU Index	*CU Name*	*Run Timing*	*Life History (Predominant Age at Maturity)*	*JAZ (FAZ+MAZ)*	*Maximum number of populations (former number)*	*Comments and rationale for changes*
CK-02	Boundary Bay	Fall	Ocean type (unk)	BB+GStr	3 (3)	No changes.
CK-03	Lower Fraser River-fall timing (white)	Fall	Ocean type (0.3)	LFR+GStr	1 (1)	No changes.
CK-04	Lower Fraser River-spring timing	Spring	Stream type (1.3)	LFR+GStr	7 (5)	Site adjustments.
CK-05	Lower Fraser River-Upper Pitt	Summer	Stream type (1.3)	LFR+GStr	2 (1)	Site adjustments.
CK-06	Lower Fraser River-summer timing	Summer	Stream type (1.3)	LFR+GStr	9 (11)	Site adjustments.
CK-07	Maria Slough	Summer	Ocean type (0.3)	LFR+GStr	1 (1)	No changes.
CK-08	Fraser Canyon-Nahatlatch	Spring	Stream type (1.3)	FRCany+ GStr	2 (1)	Site adjustments.
CK-09	Middle Fraser River-Portage	Fall	Stream type (1.3)	MFR+GStr	1 (1)	No changes.
CK-10	Middle Fraser River-spring timing	Spring	Stream type (1.3)	MFR+GStr	42 (22)	Site adjustments.
CK-11	Middle Fraser River-summer timing	Summer	Stream type (1.3)	MFR+GStr	24 (22)	Site adjustments.
CK-12	Upper Fraser River-spring timing	Spring	Stream type (1.3)	UFR+GStr	40 (40)	Site adjustments.
CK-13	South Thompson River-summer timing-age0.3	Summer	Ocean type (0.3)	STh+GStr	4 (8)	Site adjustments.
CK-14	South Thompson River-summer timing-age1.3	Summer	Stream type (1.3)	STh+GStr	4 (2)	Site adjustments.
CK-15	Shuswap River-summer timing-age0.3	Summer	Ocean type (0.3)	STh+GStr	3 (2)	Site adjustments.
CK-16	South Thompson River-Bessette Creek	Summer	Stream type (1.2)	STh+GStr	4 (4)	No changes.
CK-17	Lower Thompson River-spring timing-age1.2	Spring	Stream type (1.2)	LTh+GStr	12 (10)	Site adjustments.

CU Index	CU Name	Run Timing	Life History (Predominant Age at Maturity)	JAZ (FAZ+MAZ)	Maximum number of populations (former number)	Comments and rationale for changes
CK-18	North Thompson River-spring timing- age 1.3	Spring	Stream type (1.3)	NTh+GStr	8 (7)	Site adjustments.
CK-19	North Thompson River-summer timing-age1.3	Summer	Stream type (1.3)	NTh+GStr	7 (7)	Site adjustments.
CK-20	South Coast-Georgia Strait	Fall	Ocean type (0.4)	SC+GStr	45 (46)	Site adjustments.
CK-21	East Vancouver Island-Goldstream	Fall	Ocean type (0.4)	EVI+GStr	2 (2)	No changes.
CK-22	East Vancouver Island-Cowichan & Koksilah	Fall	Ocean type (0.3)	EVI+GStr	7 (7)	No changes.
CK-23	East Vancouver Island-Nanaimo-spring timing	Spring	Stream type (1.3)	EVI+GStr	1 (1)	No changes.
CK-24	East Vancouver Island-summer timing	Summer	Ocean type (0.4)	EVI+GStr	3 (1)	Name changed to reflect merger. Site adjustments.
CK-25	East Vancouver Island - Nanaimo & Chemainus-fall timing	Fall	Ocean type (0.3)	EVI+GStr	4 (4)	No changes.
CK-26	East Vancouver Island - Puntledge - summer timing				0 (1)	Based on genetics, ecotype and run timing data, CU merged with CK-24.
CK-27	East Vancouver Island-Qualicum & Puntledge-fall timing	Fall	Ocean type (0.4)	EVI+GStr	10 (20)	Site adjustments.
CK-28	South Coast –southern fjords	Fall	Ocean type (0.4)	SC+SFj	15 (26)	Site adjustments.
CK-29	Northeast Vancouver Island	Fall	Ocean type (0.4)	EVI+SFj	14 (14)	Site adjustments.
CK-30	Port San Juan				0 (5)	Based on revised run timing analysis and genetics, CU merged with CK-31.
CK-31	Southwest Vancouver Island	Fall	Ocean type (0.4)	WVI+WVI	53 (59)	Site adjustments.
CK-32	Nootka & Kyuquot	Fall	Ocean type (0.4)	WVI+WVI	44 (57)	Site adjustments.
CK-33	Northwest Vancouver Island	Fall	Ocean type (0.4)	WVI+WQCI	10 (17)	No changes.
CK-34	Homathko	Summer	Ocean type (0.4)	HK+SFj	2 (2)	No changes.
CK-35	Klinaklini	Summer	Ocean type (0.4)	HK+SFj	2 (2)	No changes.

CU Index	CU Name	Run Timing	Life History (Predominant Age at Maturity)	JAZ (FAZ+MAZ)	Maximum number of populations (former number)	Comments and rationale for changes
CK-82	South Thompson-Adams River Upper	Summer	Ocean type (unk)	STh+GStr	1 (0)	New CU. Does not fit with any other South Thompson CU.
CK-9000	Hatchery Exclusion-Lower Fraser River	Fall	Ocean type (0.4)	LFR + GStr	1 (1)	
CK-9001	Hatchery Exclusion-Barkley Sound				0 (5)	Based on prior existence of natural populations, merged with CK-31.

Table 3. Proposed revisions and/or additions to populations of southern BC Chinook within CUs, sorted by new CU Index number.

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
46111	Green River	CK-04	Lower Fraser River-spring timing	Add: Fish observed during assessment survey.
<na>	Coquitlam River	CK-04	Lower Fraser River-spring timing	Add: Likely extirpated, inaccessible spawning habitat since dam construction.
<na>	Ryan River	CK-04	Lower Fraser River-spring timing	Add: Spawners observed during assessment survey.
<na>	Blue Creek	CK-05	Lower Fraser River-Upper Pitt	Add: StAD escapement data supports addition.
47156	Anderson River	CK-08	Fraser Canyon-Nahatlatch	Moved from CK-11, based on geography, but then excluded due to lack of evidence of Chinook.
47229	Bridge River	CK-10	Middle Fraser River-spring timing	Moved from CK-11, based on run timing (Parken et al. 2008)
45510	Endako River	CK-10	Middle Fraser River-spring timing	Moved from CK-11, based on genetic run timing.
45520	Shovel Creek	CK-10	Middle Fraser River-spring timing	Moved from CK-11 based on genetic run timing and geography (it is a tributary of Endako River)
47234	Yalakom River	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Beece Creek	CK-10	Middle Fraser River-spring timing	Add: Taseko Lake tributary
<na>	Big Creek	CK-10	Middle Fraser River-spring timing	Add: Needs to be confirmed with local knowledge. Chilcotin tributary.
<na>	Clisbako	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Coglistiko River	CK-10	Middle Fraser River-spring timing	Add: West Road tributary
<na>	Dust Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Euchiniko Creek	CK-10	Middle Fraser River-spring timing	Add: West Road tributary
<na>	Fyfe Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK indicates Chinook presence.
<na>	Little River	CK-10	Middle Fraser River-spring timing	Add: Upper Cariboo tributary

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
<na>	Lord River	CK-10	Middle Fraser River-spring timing	Add: Taseko Lake tributary
<na>	Minton Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Nadina River	CK-10	Middle Fraser River-spring timing	Add: Visual observations in 2008 and 2011. Not proximate to other populations.
<na>	Sakeniche River	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Snaking Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Sowchea Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Stone Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Tchaikazan Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK ATK, Taseko Lake tributary
<na>	Upper Taseko River	CK-10	Middle Fraser River-spring timing	Add: Taseko Lake tributary
<na>	Victoria Creek	CK-10	Middle Fraser River-spring timing	Add: LEK/ATK
<na>	Yohetta Creek	CK-10	Middle Fraser River-spring timing	Add: Taseko Lake tributary
<na>	Baptiste Creek	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
<na>	Dog Creek	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
<na>	Leo Creek	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
<na>	Nancut Creek	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
<na>	Natazutlo Creek	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
<na>	Necoslie River	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
<na>	Pitka Creek	CK-11	Middle Fraser River-summer timing	Add: LEK/ATK
47317	Salmon River	CK-12	Upper Fraser River-spring timing	Moved from CK-10. EPAD data supports change.
<na>	Red Mountain Creek	CK-12	Upper Fraser River-spring timing	Add: EPAD indicates release of Fontoniko Creek Chinook. Further investigation required.
46165	Lower Thompson River	CK-13	South Thompson River-summer timing-age0.3	Moved from CK-17 based on expert opinion, supported by factor analysis.
46336	Seymour River	CK-14	South Thompson River-summer timing-age1.3	Moved from CK-13. Scale age data supports change.
46407	Salmon River	CK-14	South Thompson River-summer timing-age1.3	Moved from CK-13. EPAD data supports change.
46527	Wap Creek	CK-15	Shuswap River-summer timing-age0.3	Moved from CK-13 based on expert opinion.
<na>	Criss Creek	CK-17	Lower Thompson River-spring timing-age1.2	Add: Deadman River tributary
<na>	Hat Creek	CK-17	Lower Thompson River-spring timing-age1.2	Add: Bonaparte River tributary

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
<na>	Maka Creek	CK-17	Lower Thompson River-spring timing-age1.2	Add: Spius Creek tributary
<na>	Mud River	CK-18	North Thompson River-spring timing- age 1.3	Add: Location and size supports possibility of Chinook escapement. Further investigation required.
<na>	North Thompson River - Upper	CK-18	North Thompson River-spring timing- age 1.3	Add: Upper N Thompson to spring timing (above Vavenby). Population structure raises questions.
<na>	Thunder River	CK-18	North Thompson River-spring timing- age 1.3	Add: Location and size supports possibility of Chinook escapement. Further investigation required.
46730	Mad River	CK-18	North Thompson River-spring timing- age 1.3	Moved from CK-19 based on expert opinion and productivity.
46718	Raft River	CK-19	North Thompson River-summer timing-age1.3	Moved from CK-18 based on expert opinion, supported by factor analysis.
53068	Puntledge River Summer	CK-24	East Vancouver Island- summer timing	Moved from CK-26 based on similar genetics, behaviour and run timing.
<na>	Cowichan River Summer	CK-24	East Vancouver Island- summer timing	Add: Will need to collect DNA samples in order to confirm this population exists. Request for ATK/LEK has been sent.
52918	Campbell River	CK-29	Northeast Vancouver Island	Moved from CK-27 to join with tributary (Quinsam River) assignment.
52898	Menzies Creek	CK-29	Northeast Vancouver Island	Moved from CK-27 based on geographic location.
52908	Mohun Creek	CK-29	Northeast Vancouver Island	Moved from CK-27 based on geographic location.
40323	Gordon River	CK-31	Southwest Vancouver Island	Moved from CK-30 based on CU merger.
40293	Harris Creek	CK-31	Southwest Vancouver Island	Moved from CK-30 based on CU merger.
40313	Lens Creek	CK-31	Southwest Vancouver Island	Moved from CK-30 based on CU merger. Less than 6 NuSEDS estimates.
40283	Renfrew Creek	CK-31	Southwest Vancouver Island	Moved from CK-30 based on CU merger.
40253	San Juan River	CK-31	Southwest Vancouver Island	Moved from CK-30 based on CU merger.
40548	Somass River	CK-31	Southwest Vancouver Island	Moved from CK-9001 based on similar timing, genetics and geographic location.
40569	Deer Creek	CK-31	Southwest Vancouver Island	Moved from CK-9001 based on similar timing, genetics and geographic location.
40583	Drinkwater Creek	CK-31	Southwest Vancouver Island	Moved from CK-9001 based on similar timing, genetics and geographic location.
3306	Somass-Sproat- GC System	CK-31	Southwest Vancouver Island	Moved from CK-9001 based on similar timing, genetics and geographic location.
33064	Stamp River – Above Falls	CK-31	Southwest Vancouver Island	Moved from CK-9001 based on similar timing, genetics and geographic location.
<na>	Sproat River	CK-31	Southwest Vancouver Island	New: LEK and DFO information.

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
<na>	Taylor River	CK-31	Southwest Vancouver Island	New: LEK and DFO information.
<na>	Gracie Creek	CK-31	Southwest Vancouver Island	New: LEK
<na>	Ash River	CK-31	Southwest Vancouver Island	New: LEK
<na>	McBride Creek	CK-31	Southwest Vancouver Island	New: LEK
46256	Adams River-Upper	CK-82	<new>	Re-colonized population from unknown source. Does not fit with any proximate CUs. Recommend new CU.
<na>	Cowichan River Spring	<na>	<new>	Add: LEK, more information required.
60008	Lafarge Lake	<na>	<remove>	Remove from CK-04. No NuSEDS records or local knowledge of Chinook presence.
46048	Weaver Creek	<na>	<remove>	Remove from CK-06. Few NuSEDS records exist and suggest unviable strays from other systems.
47219	Gates River	<na>	<remove>	Remove from CK-11. No records at counting fence, no local knowledge of Chinook presence. 1 NuSEDS record (1958).
46658	Dunn Creek	<na>	<remove>	Remove from CK-18. No Chinook habitat.
46668	McTaggart Creek	<na>	<remove>	Remove from CK-18. No Chinook habitat.
60012	Kallahne Creek	<na>	<remove>	Remove from CK-20. No NuSEDS records exist.
48792	Angus Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
48922	Brittain River	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
48762	Carlson Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
52858	Drew Creek	<na>	<remove>	Remove from CK-20. Sea pen strays from an outside CU population source.
49858	Hastings Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
52848	McKercher (Hyacinthe Creek)	<na>	<remove>	Remove from CK-20. Sea pen strays from an outside CU population source.
50108	McNab Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
49813	Noons Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
48717	Pender Harbour Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
48642	Roberts Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
48802	Shannon Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
49912	Stawamus River	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
50498	Tahumming River	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
48862	Vancouver River	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
48662	Wilson Creek	<na>	<remove>	Remove from CK-20. Less than 6 NuSEDS estimates.
53018	Black Creek	<na>	<remove>	Remove from CK-27. Less than 6 NuSEDS estimates.
51448	Bonnell Creek	<na>	<remove>	Remove from CK-27. No NuSEDS records exist.
51438	Nanoose Creek	<na>	<remove>	Remove from CK-27. Less than 6 NuSEDS estimates.
51358	Nile Creek	<na>	<remove>	Remove from CK-27. Less than 6 NuSEDS estimates.
51298	Rosewall Creek	<na>	<remove>	Remove from CK-27. Less than 6 NuSEDS estimates.
52038	Trent River	<na>	<remove>	Remove from CK-27. No NuSEDS records exist.
52978	Woods Creek	<na>	<remove>	Remove from CK-27. Less than 6 NuSEDS estimates.
50988	Ahta River	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
50628	Fanny Bay Creek	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
50678	Frazer Creek	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
50848	Glendale Creek	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
50748	Robber's Knob Creek	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
49532	Seymour River	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
50728	Shoal Creek	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
50718	Tuna River	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
49612	Waump Creek	<na>	<remove>	Remove from CK-28. Less than 6 NuSEDS estimates.
52868	Granite Bay Creek	<na>	<remove>	Moved from CK-27 to CK-29. Remove due to less than 6 NuSEDS estimates.
52593	Keogh River	<na>	<remove>	Remove from CK-29. Less than 6 NuSEDS estimates.
52528	Nahwitti River	<na>	<remove>	Remove from CK-29. Less than 6 NuSEDS estimates.
60010	Woss River	<na>	<remove>	Remove from CK-29. No NuSEDS records exist.
41133	Atleo River	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40408	Campus Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40728	Canoe Pass Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40478	Carnation Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40768	Cataract Crerek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40508	Coleman Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
40488	Consinka Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40373	Doobah Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
39588	Itatsoo Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40788	Lucky Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40608	Macktush Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
39548	Maggie Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40778	Pipesteam Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40638	Snug Basin Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
42298	Sutton Mill Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40438	Sugsaw Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
39578	Twin Rivers West Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
40718	Wallace Creek	<na>	<remove>	Remove from CK-31. Less than 6 NuSEDS estimates.
41603	Black Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41823	Cachalot Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41413	Cougar Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
40898	Elaine Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41773	Eliza East River	<na>	<remove>	Remove from CK-32. No NuSEDS records exist.
41593	Inner Basin Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
39618	Jansen Lake Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41813	Kapoose Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41538	Kendrick Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41383	McCurdy Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41623	Owossitsa Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41803	Porritt Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
41793	Tatchu Creek	<na>	<remove>	Remove from CK-32. Less than 6 NuSEDS estimates.
42343	Denad Creek	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.
42353	Galato Creek	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.
42333	Klayina Creek	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.

POP_ID	Population Name	CU Index	CU Assignment	Rationale & Comments
39848	Klootchlimmis Creek	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.
42403	San Josef River	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.
42113	Stephens Creek	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.
42133	Wanokana Creek	<na>	<remove>	Remove from CK-33. Less than 6 NuSEDS estimates.

Appendix C: Complete list of Southern BC Chinook Conservation Units and Sites[1]

(As of February 6, 2013)

CK-02: Boundary Bay

In	Sites	In	Sites	In	Sites
✓	Campbell River		Serpentine River		Nicomekl River

CK-03: Lower Fraser River – fall timing (white)

In	Sites
✓	Harrison River

CK-04: Lower Fraser River – spring timing

In	Sites	In	Sites	In	Sites
	(Alouette River (EXT))		(*Coquitlam River* (EXT))		*Ryan River*
✓	Birkenhead River		*Green River*	✓	(Stave River (EXT))
✓	(Chehalis River)				

CK-05: Lower Fraser River – Upper Pitt

In	Sites
✓	Pitt River - Upper
	- *Blue Creek*

CK-06: Lower Fraser River – summer timing

In	Sites	In	Sites	In	Sites
✓	Big Silver Creek		Douglas Creek		Sloquet Creek
✓	(Chilliwack River)	✓	Lillooet River – Lower & Upper		Tipella Creek
	Cogburn Creek				

CK-07: Maria Slough

In	Sites
✓	Maria Slough

CK-08: Fraser Canyon – Nahatlatch

In	Sites	In	Sites
✓	Nahatlatch River		Anderson River

CK-09: Middle Fraser River – Portage

In	Sites
✓	Portage Creek

CK-10: Middle Fraser River – spring timing

In	Sites	In	Sites	In	Sites
✓	Baker Creek	•	- Swift River		Taseko Lake Aggregate
✓	Bridge River Aggregate		- *Victoria Creek*		- *Beece River*
•	- Bridge River		Driftwood River		- *Lord River*
	- *Yalakom River* (EXT?)		*Dust Creek*		- *Tchaikazan Creek*
	Cariboo River -Upper & *Little River*	✓	Endako River & Shovel Creek		- *Upper Taseko River*
✓	Chilako River & *Fyfe Creek*	✓	Horsefly River & McKinley Creek		- *Yohetta Creek*
✓	Chilcotin River Aggregate		*Minton Creek*	✓	Westroad Aggregate
•	- Chilcotin River - Upper		*Nadina River*	•	- Baezaeko River
•	- Chilcotin River - Lower	✓	Narcosli Creek		- *Clisbako River*
	- *Big Creek*	✓	Naver Creek		- *Coglistiko River*
	Churn Creek		*Sakeniche River*		- *Euchiniko River*
✓	Cottonwood Aggregate		*Sowchea Creek*	•	- Nazko River
•	- Ahbau Creek		Stein River		- *Snaking Creek*
•	- Cottonwood River - Upper		*Stone Creek*	•	- Westroad (Blackwater) River
•	- Lightning Creek				

[1] ✓ indicates persistent census sites (historically or currently) that will be used for future analyses.
- Bulleted census sites indicate tributaries that are grouped under the mainstem river.
• indicates persistent census sites within tributaries that will be included in future analyses as aggregates of mainstem systems
italicized census sites are new additions from this review
(EXT) indicates census sites where Chinook are no longer observed and/or enumerated.

CK-11: Middle Fraser River – summer timing

In	Sites
	Baptiste Creek
✓	Cariboo River
✓	Chilko River
	Dog Creek (EXT)
✓	Elkin Creek
	Kazchek Creek & Middle River
	Leo Creek
	Mitchell River
	Nancut Creek
	Natazutlo Creek
✓	Nechako River
	Necoslie River
	Ormond Creek (EXT?)
✓	Pinchi Creek
	Pitka Creek
✓	Quesnel River
	Seton & Cayoosh Creeks
	Seton River
	Stellako River
	Stuart River
✓	Tachie River & Kuzkwa River
✓	Taseko River

CK-12: Upper Fraser River – spring timing

In	Sites
✓	Bowron Aggregate
•	- Antler Creek
•	- Bowron River
•	- Haggen Creek
•	- Indianpoint Creek
	- Sus Creek
	Dome Creek
	Driscoll Creek
✓	East & West Twin Creeks
✓	Fraser River – Above Tete Jaune Cache
✓	Goat River
✓	Holliday Creek
✓	Holmes River
✓	Horsey Creek
	Kenneth Creek
	McGregor-Herrick Aggregate
•	- Bad River (James Creek)
•	- Captain Creek
•	- Fontoniko Creek
	- Herrick Creek
	- Ice Creek
	- McGregor River
	- Otter Creek
•	- Seebach Creek
	- Spakwaniko Creek
✓	McKale River
✓	Morkill River & Forgetmetnot Creek
✓	Nevin Creek
	Ptarmigan Creek
	Red Mountain Creek
✓	Robson River
✓	Salmon River (POP_ID: 47317)
✓	Slim Creek
✓	Small Creek
	Snowshoe Creek
✓	Torpy Aggregate
	- Humbug Creek
•	- Torpy River
•	- Walker Creek
✓	Swift Creek
✓	Willow Aggregate
•	- Wansa Creek
•	- Willow River

CK-13: South Thompson River – summer timing – age 0.3

In	Sites
✓	Adams River (& Channel)
✓	Little River
	Thompson River - Lower
✓	South Thompson

CK-14: South Thompson River – summer timing – age 1.3

In	Sites
✓	Eagle River
✓	Salmon River (POP_ID: 46407)
	Scotch Creek
✓	Seymour River

CK-15: Shuswap River – summer timing – age 0.3

In	Sites
✓	Shuswap River – Lower
✓	Shuswap River – Middle
	Wap Creek

CK-16: South Thompson River – Bessette Creek

In	Sites
✓	Bessette Creek
	Creighton Creek
✓	Duteau Creek
	Nicklen (Harris) Creek

CK-17: Lower Thompson River – spring timing – age 1.2

In	Sites
✓	Bonaparte River Aggregate
	- Bonaparte River
	- *Hat Creek*
✓	Coldwater River (incl. Upper)
✓	Deadman River
	- *Criss Creek*
✓	Louis Creek
✓	Nicola River (incl. Upper)
✓	Spius Creek Aggregate
•	- *Maka Creek*
•	- Spius Creek (incl. Upper)

CK-18: North Thompson River – spring timing – age 1.3

In	Sites
	Albreda River
✓	Blue River
✓	Finn Creek
	Lion Creek
	Mad River
	Mud River
	North Thompson River – Upper
	Thunder River

CK-19: North Thompson River – summer timing – age 1.3

In	Sites
✓	Barriere River
✓	Clearwater River
✓	Lemieux Creek
✓	Mahood River
	Mann Creek
	North Thompson River
✓	Raft River

CK-20: South Coast – Georgia Strait

In	Sites
✓	Brem River
	- Brem River Tributary
✓	Brothers Creek
	(Capilano River)
	(Chapman Creek)
	(Indian River)
✓	(Lang Creek)
	Lynn Creek
✓	Quatam River
	Richards Creek
✓	Seymour River
✓	Skwawka River (EXT)
	(Sliammon Creek)
✓	Squamish River Aggregate
•	- Ashlu Creek
	- Branch 100 Creek
•	- Cheakamus River
•	- Chuk-Chuk Creek
	- July Creek
•	- Mamquam River
	- Mamquam Spawning Channel
	Squamish River Aggregate (cont'd)
•	- Mashiter Creek
•	- Tenderfoot Creek
•	- Shovelnose Creek
•	- Spring Creek
✓	Theodosia River
✓	Toba River Aggregate
•	- Toba & Little Toba Rivers
•	- Klite River
✓	Tzoonie River (EXT)

CK-21: East Vancouver Island – Goldstream

In	Sites
✓	(Goldstream River)
	Tod Creek

CK-22: East Vancouver Island – Cowichan & Koksilah

In	Sites
✓	Cowichan River
	- Mesachie River
	- Patricia Creek
	- Robertson River
	- Shaw Creek
✓	Koksilah River
	(Shawnigan Creek)

CK-23: East Vancouver Island – Nanaimo – spring timing

In	Sites
✓	Nanaimo River – Upper

CK-24: East Vancouver Island – summer timing

In	Sites
	Cowichan River
✓	Nanaimo River
✓	Puntledge River

CK-25: East Vancouver Island – Nanaimo & Chemainus – fall timing

In	Sites
✓	Chemainus River
✓	Nanaimo River
	- Haslam Creek
	- Napoleon Creek

CK-27: East Vancouver Island – Qualicum & Puntledge – fall timing

In	Sites
✓	Englishman River
✓	Little Qualicum River
	(Oyster River)
	(Puntledge River)
	- Tsolum River
	- Morrison Creek
✓	Qualicum River
	Simms Creek
	Tsable River
	Willow Creek

CK-28: South Coast – Southern Fjords

In	Sites
✓	Ahnuhati River
✓	Apple River
✓	Franklin River
	Fulmore River
	Heydon River
✓	Kakweiken River
✓	Kingcome River
	Kwalate Creek
✓	Orford River
✓	Phillips River
✓	Sim River
✓	Southgate River (EXT?)
✓	Stafford River
✓	Teaquahan River (EXT?)
✓	Wakeman River

CK-29: Northeast Vancouver Island

In	Sites
✓	Adam & Eve Rivers
	Amor de Cosmos Creek
✓	Campbell River
•	- Quinsam River
	Cluxewe River
✓	Kokish River
	Menzies Creek
	Mohun Creek
✓	Nimpkish River
	Quatse River
✓	Salmon River (POP_ID: 52718)
	Tsitika River
	White River

CK-31: Southwest Vancouver Island

In	Sites
✓	Bedwell System
	Caycuse River
	China Creek
✓	Coeur D'Alene Creek
✓	Cous Creek (EXT)
✓	Cypre River
✓	Effingham River
✓	Franklin River
✓	Gordon River
✓	Henderson Lake Creek
•	- Clemens Creek
✓	Ice River
✓	Kennedy River Aggregate
•	- Kennedy River-Lower
•	- Kennedy River- Upper
•	- Kennedy Lake Beaches & Feeder Streams
•	- Muriel Lake

In	Sites
	Kennedy River Aggregate (cont'd)
•	- Clayoquot River-Lower & Upper
•	- Sand River
	Klanawa River
✓	Megin River
✓	Mercantile Creek
✓	Moyeha Creek
✓	Nahmint River
✓	Nitinat River
✓	San Juan River Aggregate
	- Harris Creek
•	- Renfrew Creek
•	- San Juan River
✓	Sarita River
✓	Sooke River Aggregate
	- Ayum Creek
	- Rocky Creek
	- Charters River

In	Sites
✓	Somass River Aggregate
	- *Ash River*
	- Deer Creek
	- Drinkwater Creek
	- *Gracie Creek*
	- *McBride Creek*
•	- Stamp River-Above Falls
	- *Sproat River*
	- Somass-Sproat-Great Central System
•	- *Taylor River*
	Smith Creek
✓	Sydney Creek
✓	Thornton Creek
✓	Tofino Creek (EXT)
✓	Toquart Creek & Little Toquart Creek
✓	Tranquil Creek
	Uchuck Creek (EXT)
✓	Warn Bay Creek
✓	Watta Creek

CK-32: Nootka & Kyuquot

In	Sites
	Amai Creek
✓	Artlish River
	Battle Bay River
	Brodick Creek
✓	Burman River
✓	Canton Creek
	Chamiss Creek (EXT)
	Chum Creek
	Clanninick Creek (EXT)
✓	Conuma River
✓	Deserted Creek (EXT)
	Easy Creek
	Eliza Creek (EXT)
✓	Espinosa Creek
✓	Gold River Aggregate

In	Sites
✓	- Muchalat River
	- Oktwanch River
	Hoiss Creek
	Houston River
✓	Jacklah River (EXT)
✓	Kaouk River
	Kashutl River (EXT)
✓	Kauwinch River
✓	Kleeptee Creek
✓	Leiner River
✓	Little Zebellos River
✓	Malksope River
	Mamat Creek (EXT)
	Marvinas Bay Creek
	McKay Cove Creek

In	Sites
✓	Mooyah River
	Narrowgut Creek (EXT)
	Nasparti River
✓	Ououkinsh River
✓	Park River (EXT)
✓	Power River
	Silverado Creek (EXT)
✓	Sucwoa River
✓	Tahsis River
✓	Tahsish River
	- *Silburn Creek*
✓	Tlupana River
✓	Tsowwin River
✓	Zebellos River

CK-33: Northwest Vancouver Island

In	Sites
✓	Cayeghle System
	- Ulluh Creek
✓	East Creek
	Goodspeed River

In	Sites
	Keith River
✓	Klaskish River
	Mahatta Creek

In	Sites
✓	Marble River
	- Benson River
	Washlawlis Creek

CK-34: Homathko

In	Sites
✓	Homathko River
	- Cumsack Creek

CK-35: Klinaklini

In	Sites
✓	Klinaklini River
	- Devereux Creek

CK-82: South Thompson – Adams River Upper

In	Sites
✓	Adams River - Upper

CK-9000 : Hatchery Exclusion – Lower Fraser River

In	Sites
✓	Chilliwack/Vedder River

This Report is Available from the

Center for Science Advice (CSA)
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ISSN 1919-3769
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Correct Citation for this Publication:

DFO. 2013. Review and update of southern BC Chinook conservation unit assignments. DFO Can. Sci. Advis. Sec. Sci. Resp. 2013/022.

Aussi disponible en français :

MPO. 2013. Examen et mise à jour des désignations d'unités de conservation du saumon quinnat du sud de la Colombie-Britannique. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2013/022.